

FIG. 1

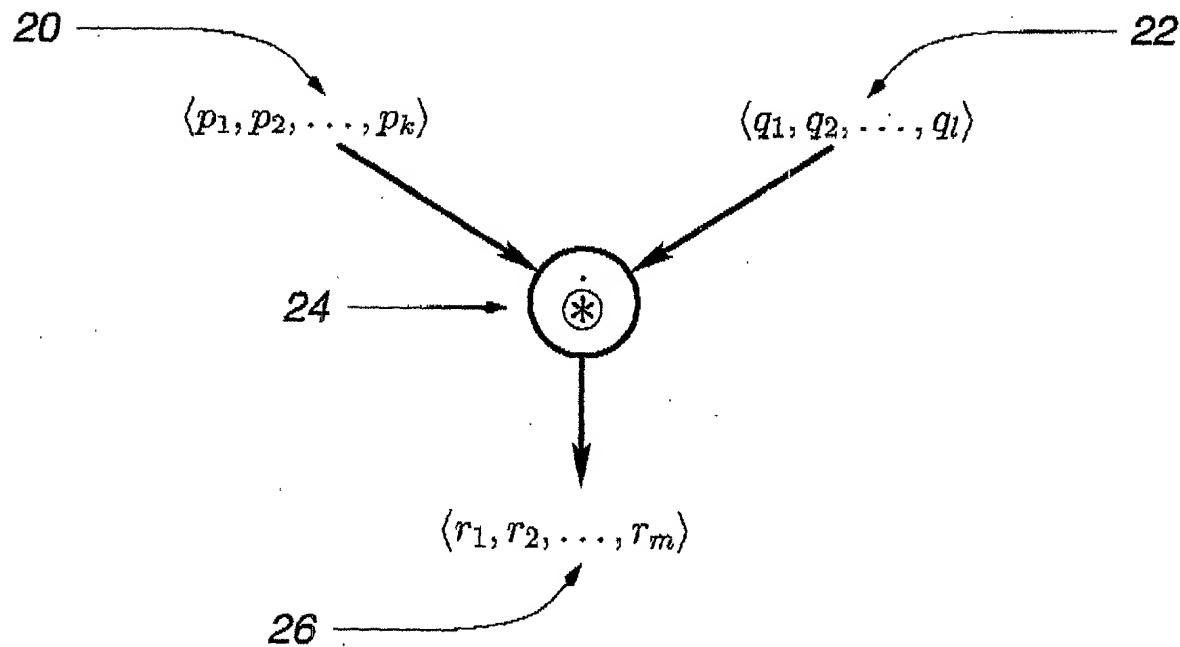


FIG. 2

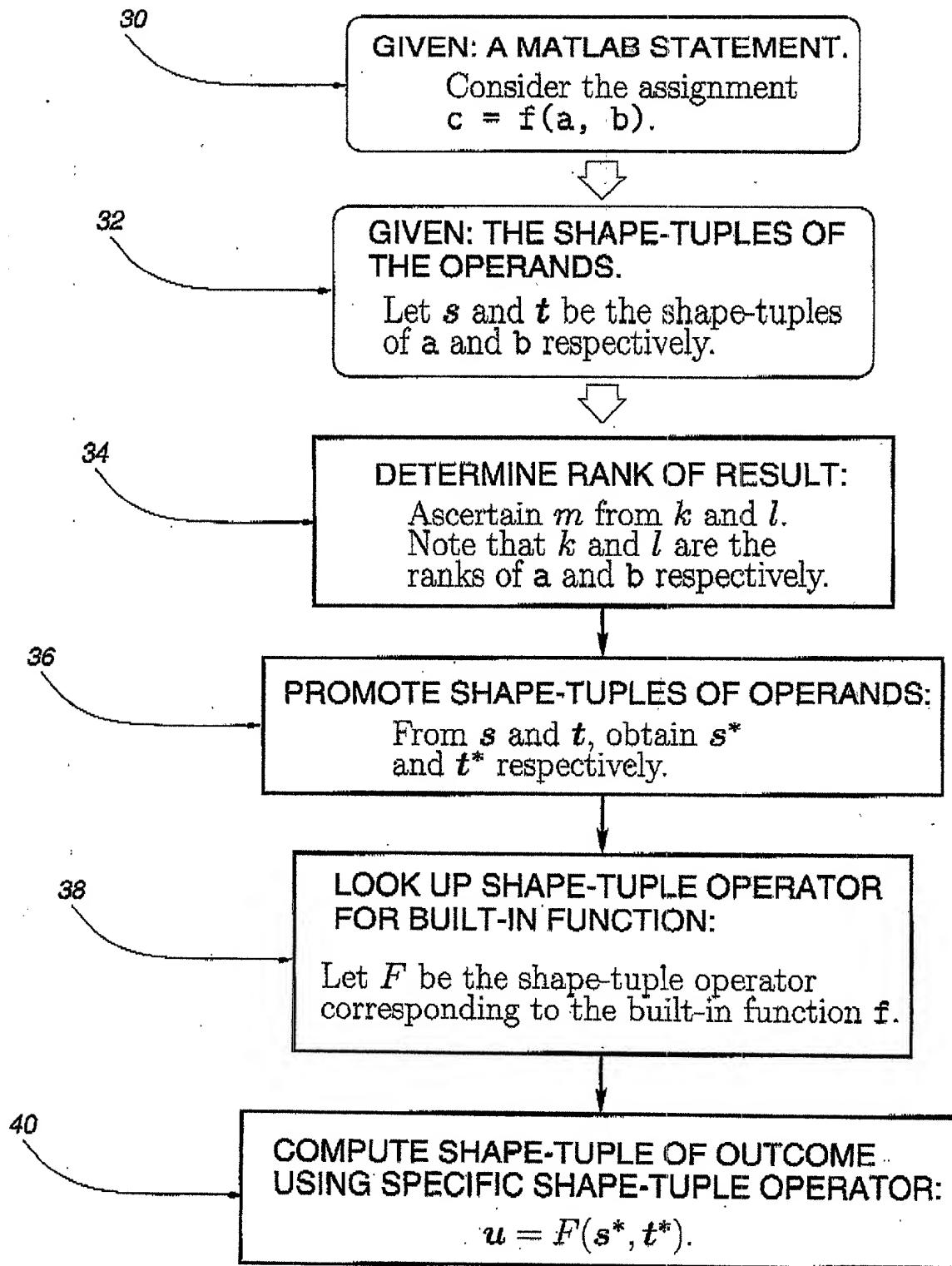


FIG. 3

<i>Operator</i>	<i>Rank</i>
$a*b$	
$a+b$	
$a-b$	
$a.*b$	
$a.^b$	
$a./b$	
$a.\backslash b$	
$a==b$	
$a~=b$	
$a< b$	$\max(R(a), R(b))$
$a> b$	
$a\leq b$	
$a\geq b$	
$a&b$	
$a b$	
$a/b$	
$a\backslash b$	
$[a, b]$	
$[a; b]$	
$+a$	
$-a$	
$^a$	$R(a)$
$a'$	
$a.$	
$c(:) \leftarrow a$	$R(c)$
$a.^b$	
$a(:)$	2
$\text{rand}$	
$a:b$	
$\text{rand}(a, b)$	2
$\text{ones}(a, b)$	
$a(e)$	$R(e)$
$a(e_1, e_2, \dots, e_n)$	
$\text{rand}(e_1, e_2, \dots, e_n)$	$n$
$\text{ones}(e_1, e_2, \dots, e_n)$	
$c(e) \leftarrow a$	$\max(R(a), R(c))$
$c(e_1, e_2, \dots, e_n) \leftarrow a$	$\max(n, R(c))$

FIG. 4

MATLAB Expression <i>e</i>	Shape Expression	$\bar{\theta}(e)$	$u$
$a*b$	$s \dot{\oplus} t$	$\bar{\theta}(a)\bar{\theta}(b)(1 - (1 - \bar{\alpha}(a))$ $(1 - \bar{\alpha}(b))(1 - \bar{\beta}(a)\bar{\beta}(b)$ $\delta(\Psi s\Psi\Gamma_1 - t\Gamma_1)))$	$(1 - \bar{\theta}(e))\pi^* + \bar{\theta}(e)(s^*\bar{\alpha}(b) +$ $t^*\bar{\alpha}(a)(1 - \bar{\alpha}(b)) + (s^*\Gamma_1 +$ $t^*\Gamma_2 + I - \Gamma_1 - \Gamma_2)(1 - \bar{\alpha}(a))$ $(1 - \bar{\alpha}(b)))$
$a+b$ $a-b$ $a.*b$ $a.^b$ $a./b$ $a.\backslash b$ $a==b$ $a~=~b$ $a<~b$ $a>~b$ $a<=b$ $a>=b$ $a&b$ $a b$	$s \dot{\oplus} t$	$\bar{\theta}(a)\bar{\theta}(b)(1 - (1 - \bar{\alpha}(a))$ $(1 - \bar{\alpha}(b))(1 - \delta(s - t)))$	$(1 - \bar{\theta}(e))\pi^* + \bar{\theta}(e)(s^*\bar{\alpha}(b) +$ $t^*(1 - \bar{\alpha}(b)))$
$+a$ $-a$ $\sim a$	$\dot{is}$	$\bar{\theta}(a)$	$s^*$
$a^-b$	$s \dot{\oplus} t$	$\bar{\theta}(a)\bar{\theta}(b)(1 - (1 - \bar{\alpha}(a)\bar{\beta}(b))$ $\delta(t\Gamma_1 - \Psi t\Psi\Gamma_1))$ $(1 - \bar{\alpha}(b)\bar{\beta}(a)\delta(s\Gamma_1 -$ $\Psi s\Psi\Gamma_1)))$	$(1 - \bar{\theta}(e))\pi^* + \bar{\theta}(e)$ $(s^*\bar{\alpha}(b) + t^*(1 - \bar{\alpha}(b)))$
$a^2$ $a..$	$\dot{-s}$	$\bar{\beta}(a)$	$(1 - \bar{\theta}(e))\pi^* + \bar{\theta}(e)\Psi s^*\Psi$
$a/b$	$s \dot{\oplus} t$	$\bar{\theta}(a)\bar{\theta}(b)(1 - \bar{\alpha}(b))(1 - \bar{\alpha}(a))$ $(1 - \bar{\beta}(b))(1 - \bar{\beta}(a)\bar{\beta}(b))$ $\delta(s\Gamma_2 - t\Gamma_2)$	$(1 - \bar{\theta}(e))\pi^* + \bar{\theta}(e)(s^*\bar{\alpha}(b) +$ $t^*(1 - \beta(b)) + (s^*\Gamma_1 + I -$ $\Gamma_1 - \Gamma_2 + \Psi t^*\Psi\Gamma_2)(1 - \bar{\alpha}(b))\beta(b)$
$a\backslash b$	$s \dot{\circ} t$	$\bar{\theta}(a)\bar{\theta}(b)(1 - \bar{\alpha}(a))(1 - \bar{\alpha}(b))$ $(1 - \bar{\beta}(a))(1 - \bar{\beta}(a)\bar{\beta}(b))$ $\delta(s\Gamma_1 - t\Gamma_1)$	$(1 - \bar{\theta}(e))\pi^* + \bar{\theta}(e)(t^*\bar{\alpha}(a) +$ $s^*(1 - \beta(a)) + (\Psi s^*\Psi\Gamma_1 + I -$ $\Gamma_1 - \Gamma_2 + t^*\Gamma_2)(1 - \bar{\alpha}(a))\beta(a)$
$[a; b]$	$s \dot{\oplus} t$	$\bar{\theta}(a)\bar{\theta}(b)\delta(s(I - \Gamma_1) -$ $t(I - \Gamma_1))$	$(1 - \bar{\theta}(e))\pi^* + \bar{\theta}(e)$ $(s^* + t^*\Gamma_1)$
$[a, b]$	$s \dot{\oplus} t$	$\bar{\theta}(a)\bar{\theta}(b)\delta(s(I - \Gamma_2) -$ $t(I - \Gamma_2))$	$(1 - \bar{\theta}(e))\pi^* + \bar{\theta}(e)$ $(s^*\Gamma_2 + t^*)$

FIG. 5

Shape-Tuple Class Operator	Identity	Associativity	Commutativity	Idempotent Law
$\oplus$	$i$	$\times$	$\times$	$\times$
$\oplus$	$i$	$\checkmark$	$\checkmark$	$\checkmark$
$\wr$	-	-	-	-
$\odot$	$i$	$\checkmark$	$\checkmark$	$\times$
$\wr$	-	-	-	-
$\oslash$	$\times$	$\times$	$\times$	$\times$
$\circ$	$\times$	$\times$	$\times$	$\times$
$\odot$	$\times$	$\checkmark$	$\checkmark$	$\times$
$\ominus$	$\times$	$\checkmark$	$\checkmark$	$\times$

FIG. 6